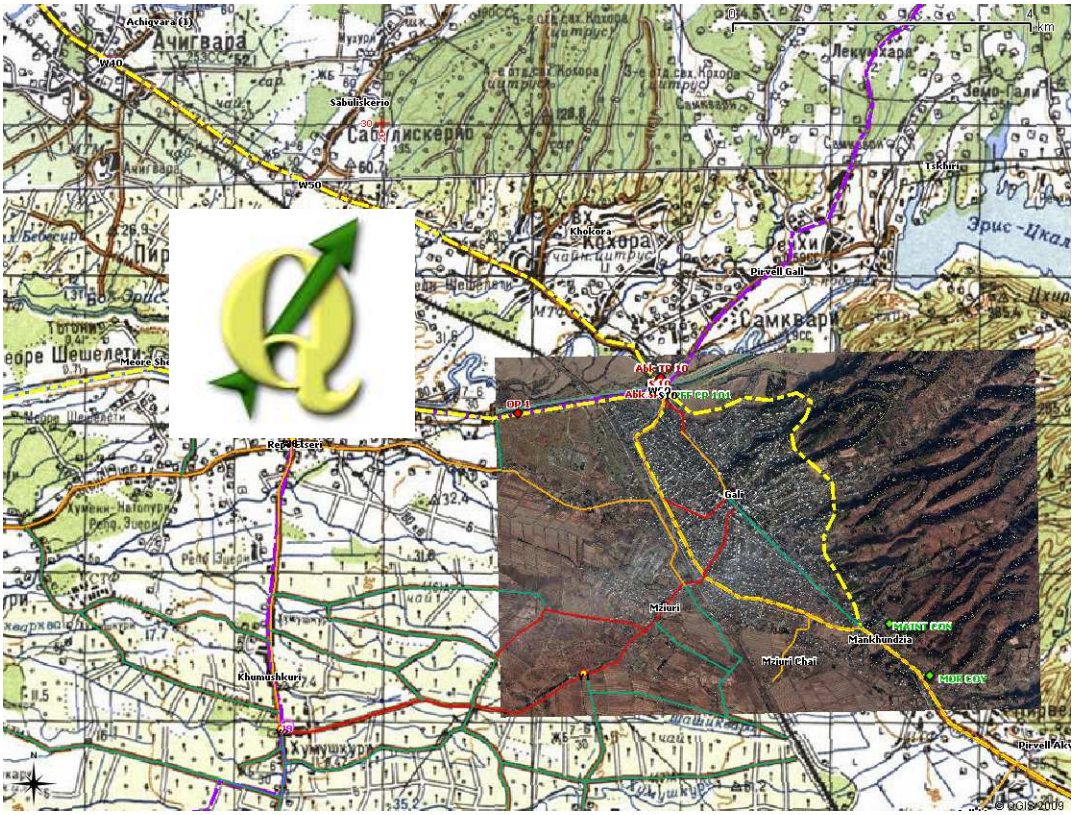
United Nations Observer Mission in Georgia (UNOMIG)
МИССИЯ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ ПО НАБЛЮДЕНИЮ В ГРУЗИИ (МООННГ)
გაეროს სადამკვირვებლო მისია საქართველოში

GIS in UNOMIG

Short Manual



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MO-664 (Swiss Army)
2009-05-10

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1 Introduction

The following handout is a non-scientific, extremely short introduction about Geographic Information Systems (GIS) with the intension that every UNMO can handle spatial data in the GALI Sector of UNOMIG. It focus how to visual geographical data (crating and printing maps) and not the analysis of geographical data. It is limited on the 2-dimensional application.

1.1 Why using GIS?

GIS stands for **G**eographical **I**nformation **S**ystem. GIS helps to manage digital data such as digitalized maps, satellite images, points, lines, and areas in order to print different maps in different scales, to store spatial information or to make different spatial analysis. GIS helps to fetch data from/to GPS-receiver (or GLONAS, GALILEO) to/from digital as well.

There are several different GIS-Software available, e.g. ESRI ArcGIS, Intergraph Geomedia, or Quantum GIS (QGIS). The first 2 software costs (full version) about 20'000 USD, QGIS is a freeware program which fulfill the today's use in GALI Sector. The big difference between commercial programs and freeware GIS programs is in the analytical functionalities. The visualizing tools are more or less similar in each GIS program. Spatial analyses are not required yet in GALI Sector and that's why QGIS is more than good enough for our purpose.

Until 2008, the maps in GALI were designed with MS PowerPoint mostly. However, PowerPoint is a program for a slideshow and not designed for managing spatial data. Even PowerPoint is well known it has a lot of disadvantages comparing to GIS products. For example, we are not able to import GPS data, we are not able to plot different maps in different scales, and we are not able to create different layers with different topics.

1.2 What is the principal of GIS?

In general we distinguish (i) geographical data, (ii) GIS projects, and (iii) printable outputs. GIS tool is able to manage different geographical data simultaneously, define projects, and to print maps.

(i) The base of each GIS are geographical data, e.g. maps, waypoints, satellite image. Geographical data has always a reference about the location in a specific coordination system. For example, when we scan a map, we have a simple picture. When we allocate additional information about the projection, the coordination system, the orientation and the location of this picture, then it becomes a map we can use in GIS.

(ii) A GIS-Project is nothing more than a user defined "mix" of different geographical data. For example we define a project on the base of the old digitalized map 1:100'000 of the U.S.S.R, on the next layer we include CFL, border between SZ and RWZ, on the next layer we include all RFF CP and ABK SP. For each category

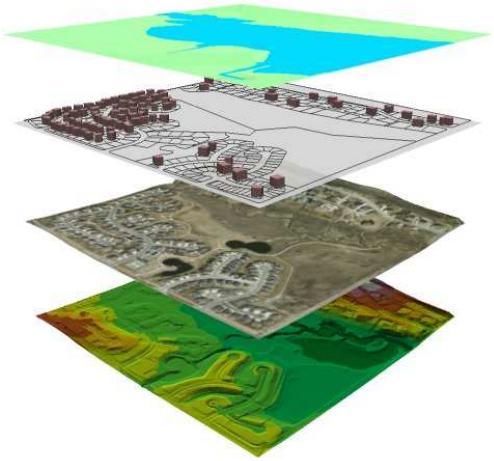


Fig. 1.1 Principal of different layers in order to create a user defined map.

of objects we can define a symbol, a color, a label, and other properties. At the end we have a user defined map based on the old soviet map including the new data of borders and checkpoints and security posts with our symbol.

(iii) When the GIS-Project is finished, we are able to print a map. Therefore we have a print composer. We can define the focus/extract of the map, the scale, a legend, the output paper size (A4 to A0), etc.

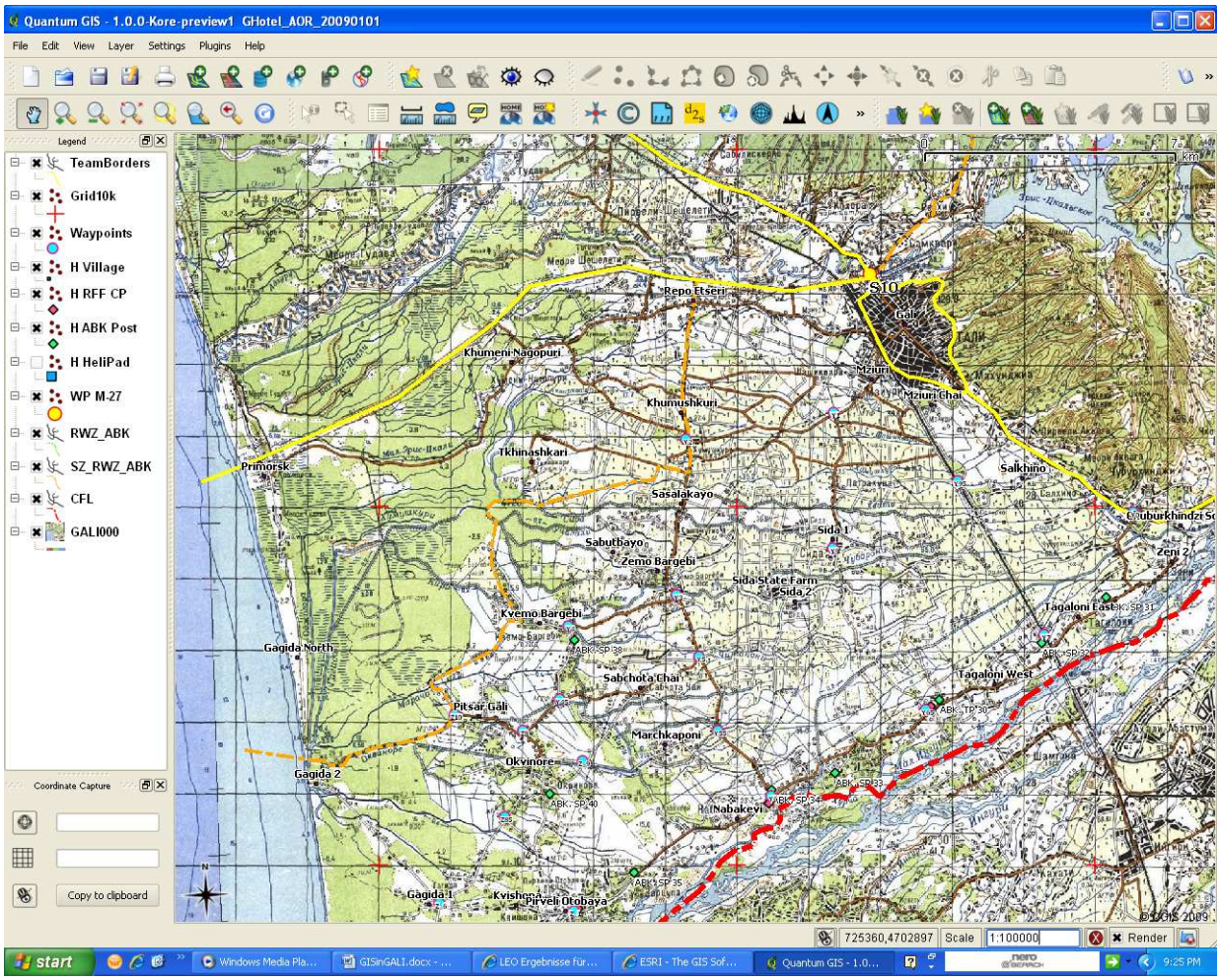


Fig. 1.2 Screenshot of Quantum GIS Software. On the left hand side the different geographical data (i.e. topics, layers) are listed, on the main window the purview of the map is shown.

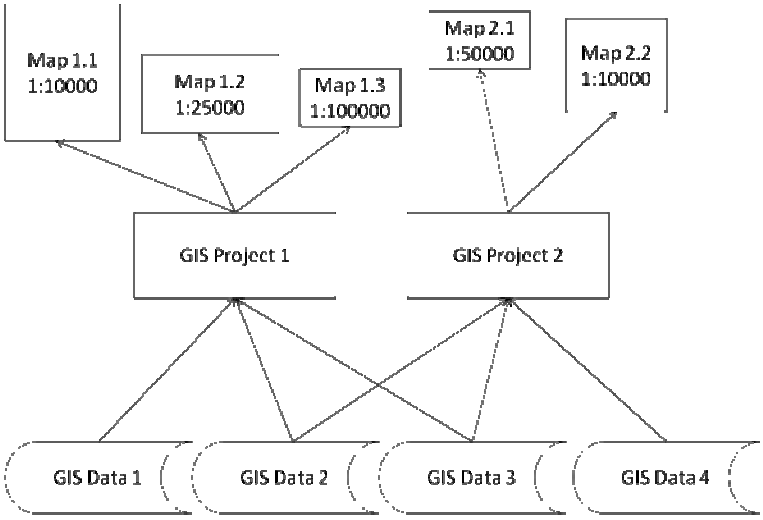


Fig. 1.3 Flow Chart of GIS. (i) GIS-Data, (ii) GIS-Projects, (iii) Maps (ready to use)

1.3 Different Type of spatial Data

We distinguish (A) Vector Data, and non vector Data such as (B) Raster Data and (C) Images.

A) Vector Data

There are 3 different types of Vector Data, points, lines, and polygons. Vector Data are also called Shapes.

A1. Point

A Point is defined by its Longitude (x, Easting) and Latitude (y, Northing). Examples: Checkpoints, Waypoints, Helipads.

In QGIS, we can assign a specific point-symbol for each different topic.

A2. Line

A line is defined by different points (start point, multiple vertices, end point). Examples: Ceasefire Line (CFL), Roads, Borders.

In QGIS we can assign a specific line-style (colour, line width, dash-dot) for each topic.

A3. Polygon

A Polygon is an area defined by a closed path (line, where start-point is identical with the end-point). Examples: Minefields, AOR, a lake.

In QGIS we can assign a specific fill-style (colour, hachures, transparency)

B) Raster Data

Raster data is a grid of cells covering an area of interest. Each pixel, the smallest unit of information in the grid, displays a unique attribute. For example, the altitude of the GALI area is stored in a Raster file with a grid resolution of 25m x 25m. Raster Data are convenient for spatial analysis. However, spatial analysis is not part of this handout.

C) Images

A satellite image, an orthophoto (equalized aerial photo) or a scanned map can be georeferenced and shown in QGIS. Each image contains pixels and therefore images are a kind of raster data as well. However, images are made for visualizing and not for analysis. The size of the pixel limits the resolution of the map. For example, the digitalized map of U.S.S.R. is good enough to print maps down to 1:50’000; when we zoom down to 1:10’000, the maps looks fuzzy.

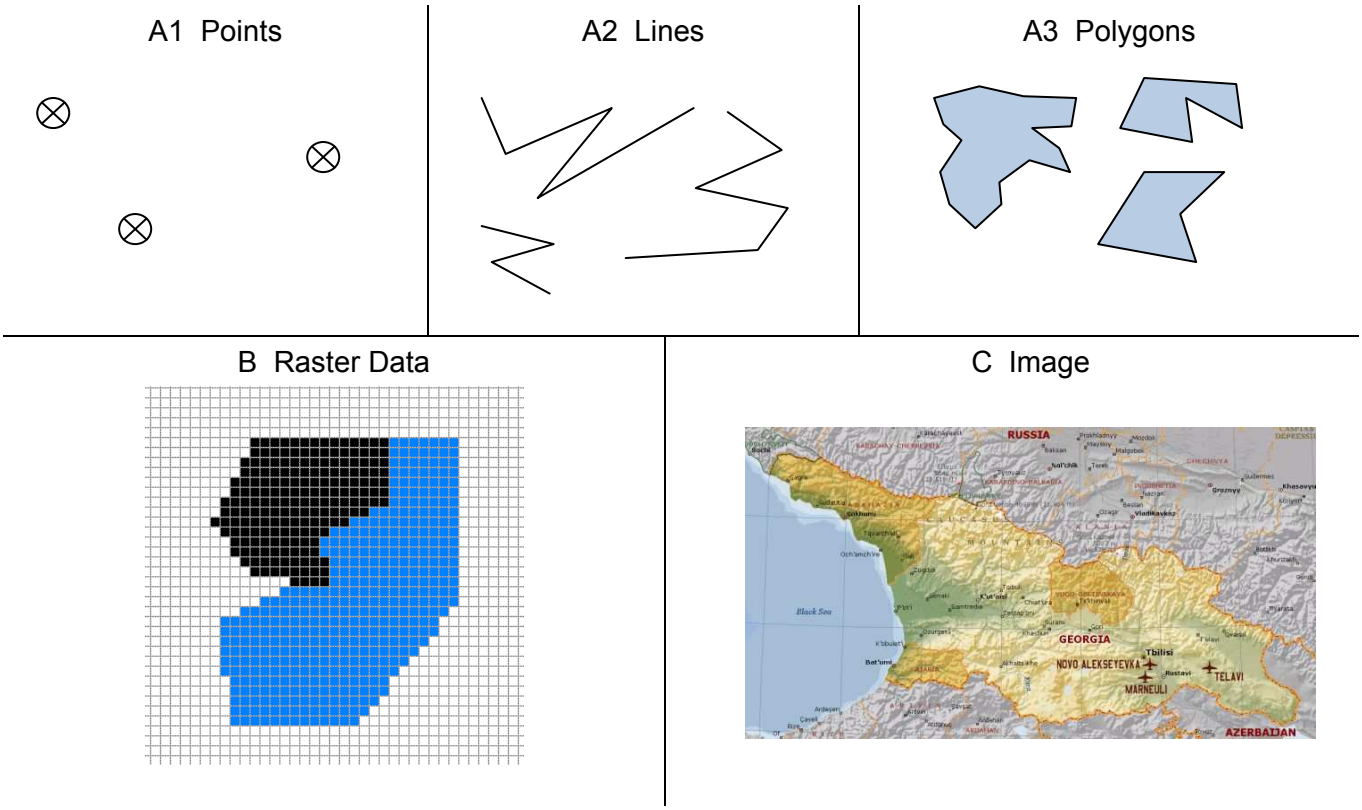


Fig. 1.4 Different types of geographical data

1.4 Projection, Coordinate System and Grid References

1.4.1 Theoretical background of projection and Coordinate System

Each location of the world can be referenced by coordinates. There are many different coordinate systems in the world which makes sometimes the life uneasy. However, it is possible to recalculate coordinates from mostly any system to another system. A coordinate system is manly defined by (1) the shape model of the globe, (2) the projection method, and (3) the origin/root.

(1) Shape of the Earth

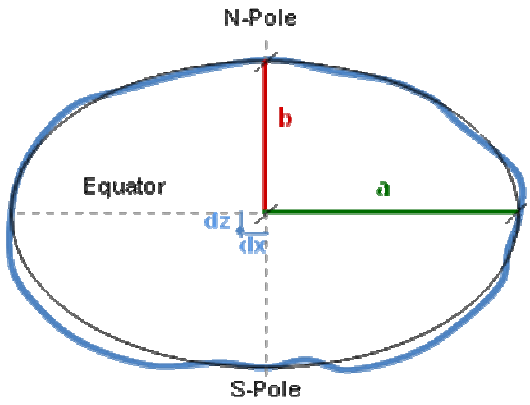


Fig. 1.5 Geoid and best fitted Ellipsoid

The shape of the Earth is nearly a spherical globe; however, the perimeter along the equator is about 134km (i.e. 0.33%) longer than the perimeter through the poles (c.f, Figure 1.5).

There are several methods to approximate the shape of the Earth. Today it is common to define the shape as an Ellipsoid, which is defined with two parameters (a) the Equatorial semi-axis, and (b) the Polar semi-axis. Some Ellipsoid does not have the center congruent to the gravity center of the Earth, which leads to additional 3 parameters (dx, dy, dz) indicating the shift. All these parameters are also known as Geodetic Datum.

Over the years, the values of these parameters are redefined in order to obtain better accuracy. Following Ellipsoid model are relevant for UNOMIG:

Shape Model	*Equatorial ½ axis [m]* **a**	*Polar ½ axis [m]* **b**	*Inverse flattening* **a/(a-b)**	*Shift of center [m]* **dx**	**dy**	**dz**
Sphere (16th century)	6'371'000		∞	unknown		
Krasovsky 1940	6'378'245	6'356'863	298.3	28	-121	-77
WGS 1984	6'378'137	6'356'752.314	298.2572236	accuracy ±2cm		

WGS 1984 (World Geodetic System 1984) is the today's standard for worldwide cartography, geodesy and navigation. Most GPS receivers use WGS'84 as reference.

The old maps of the General Staff of the former U.S.S.R. are based on the Ellipsoid of Krasovsky 1942. In GALI, the difference to WGS'84 is about +200m to East, +2000m to North.

(2) Projection Methods

Fig. 1.6 Cylindrical projection

A projection method maps the curved surface of the ellipsoid to a 2-dimensional plane. The most important methods are cylindrical-, cone-, and azimuthal- (i.e. polar-) projection. In UNOMIG the Mercator-Projection, a specific cylindrical projection, is relevant (c.f. Fig. 1.6).

For international applications, the Universal Transverse Mercator Projection System (**UTM**) is used often. The UTM-System split the globe in 60 longitudinal (Zone 1_ to 60_) and 20 latitudinal (Zone _C to _W) zones and some special zones around the poles (UPS, Universal Polar Stereographic Projection, not relevant in UNOMIG).

The old maps the General Staff of the former U.S.S.R are based on the method of Gauss-Krüger which is similar to the UTM system with minor differences.

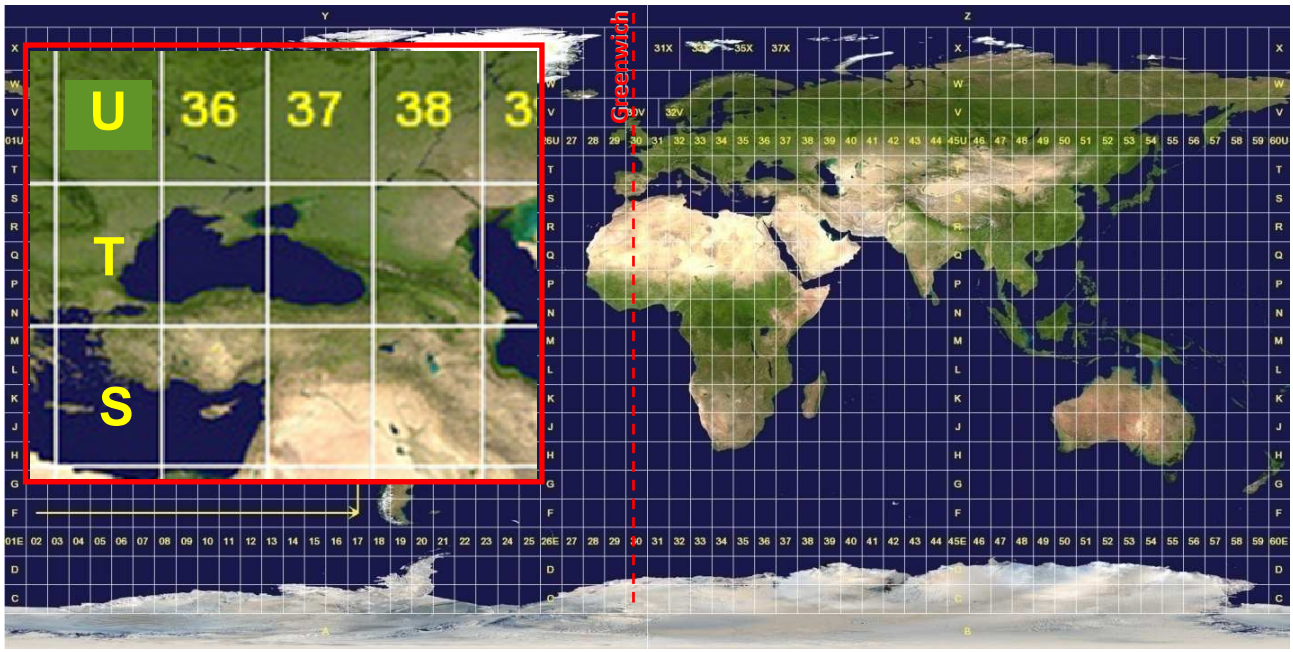


Fig. 1.7 UTM Zones

(3) Coordinate Reference System

Every point in the globe is defined by Longitude (Degree West – East from Greenwich) and Latitude (Degree South – North from Equator), when we take in account the altitude, we need an additional value for the elevation above sea level. In this case, the ellipsoid model is relevant only, no projection method is required.

However, a coordinate system with degrees, minutes and seconds is not very convenient for calculation. We are more familiar with rectangular (i.e. Cartesian) coordinate systems where the x-values indicate the distance to East, the y-value indicates the distance to North and -- if required -- a z-value indicates the altitude from a given level.

Rectangular coordinate systems are close related to the projection method. It refers to a specific Earth model (e.g. WGS'84) a specific projection method (e.g. UTM) and the unit (normally meters), the origin/root or reference point of the coordinate system (i.e. central meridian, false easting, false northing). The latter is normally defined by the specific zones.

In UNOMIG, following Coordinate Reference Systems are relevant:

- WGS'84 / UTM, Zone 37 and Zone 38 (c.f. Subsection 1.4.2)
- Krasovsky 1940 / Pulkovo 1942, Gauss-Krüger Zone 7 and Zone 8 (c.f. Subsection 1.4.3)

1.4.2 Coordinate Reference System "UTM"

GALI-Sector lies in the Zone **UTM 37 T**. ZUGDIDI-Sector lies in 2 Zones, the western part remains in **UTM 37 T** (36ºE to 42ºE), the eastern part lays in **UTM 38 T** (42ºE to 48ºE). Due to the fact the y-Value of the coordinates is continuous starting at the Equator, the latitudinal Zone indication can be reduced to the **N**orthern or **S**outhern Hemisphere. For example, UTM 37 **T** lies in UTM 37 **N**orth. GARMIN GPS shows UTM 37 T, QGIS uses UTM 37 N.

UTM use normally the Earth shape model WGS'84.

1.4.3 Coordinate Reference System "Pulkovo 1942"

Similar to UTM, Pulkovo split the globe as well in different Zones. He used the Projection Method of Gaus-Krüger (GK). Zone GK-1 over spans Longitude 0ºE to 6ºE, GK-7 form 36ºE to 42ºE, GK-8 from 42ºE to 48ºE.

The shape of the Earth is assumed as the Ellipsoid of Krasowsky 1940" and not WGS'84, unfortunately.

Pulkovo introduced a false Easting of GK-7 = 7500000m, GK-8 = 8500000. Every x-value in Zone GK-7 starts with 7…, in GK-8 with 8… respectively.

Pulkovo and UTM produce nearly the same coordinates. The differences are in the numbering of the zones where UTM Zone 37 refers to GK-7, UTM Zone 38 refers to GK-8, etc. Neglecting the first digit of the x-value of Pulkovo (which represents the Zone), the coordinates are identical. However, UTM is used normally together with WGS'84 and not with Krasowsky 1940 which leads to a difference of about +200m in East direction, and +2000m in North direction.

1.4.4 EPSG Spatial Reference Index

As mentioned above, there are several different Projection and Coordinate Reference System (CRS). The European Petroleum Survey Geodesy Group (EPSG) created an index for each Projection/CRS. Here a table of the most important figures used in UNOMIG:

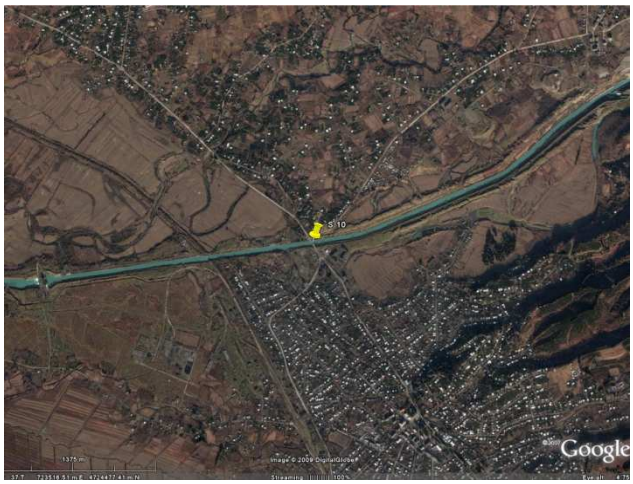
EPSG:	32637	32638	28407	38408
Short name:	WGS'84 / UTM 37 N	WGS 84 / UTM 38 N	Pulkovo 42 GK 7	Pulkovo 42 GK 8
Spheroid (Ellipsoid):	WGS 1984 major-½ axis: 6378137 m flatting: 298.257223563m		Krasowsky 1940 major-½ axis: 6378245m flatting: 298.3m	
Projection type:	Transverse Mercator			
Central Meridian:	39ºE	45ºE	39ºE	45ºE
Unit:	m [meter]			
false Easting:	500'000	500'000	7'500'000	8'500'000
false Northing:	0	0	0	0

1.4.5 Grid Reference in UNOMIG

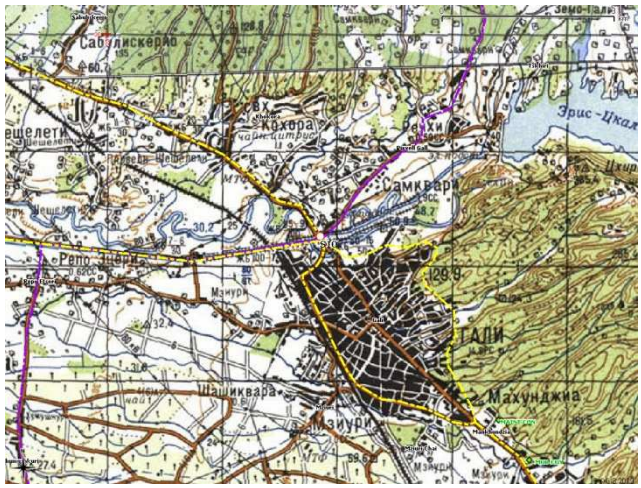
Full UTM coordinates includes the Zone, x-value (easting) and y-value (northing). If we are interested in the height we have to introduce a z-value for the altitude above sea level. x- and y-values are metric. For example, the bridge crossing the Gali Canal at S10 has the full UTM coordinate:

UTM 37 T 0723517 m 4724465 m
UTM 37 North 0723517 m 4724465 m

WGS84 / UTM coordinates (e.g. Google Earth)



Pulk42 / GK-7 coordinates (QGIS)



UTM 37 T 0723517 m 4724465 m Pulkovo 7723725 m 4726470 m

Fig. 1.8 WGS'84 / UTM coordinate-system (GPS, Google Earth) and Pulkovo 1942 / UTM coordinate system used in UNOMIG. The approximately local correction from WGS'84 to Pulkovo 1942 coordinates is about +200m East, +2000m North.

Local Correction in GPS

The Grid Reference System we use in UNOMIG is the Reference System of the former U.S.S.R. (Pulkovo 1942). This is different from the GPS which use WGS'84/UTM System. The reason is mentioned in Subsection 1.4.1. Here in UNOMIG we work with a local correction of every GPS Receiver of +200m to East, +2'000m to North. However, this local correction is an average with works in GALI AOR more or less well. There is a special documentation about this topic with the title "Confusion of Maps, the Utilisation of GPS"

Example: S10

UTM 37 T	0723517 m	4724465 m
Correction	+200 m	+2000 m
GPS Display	0723717 m	4726465 m

This correction is the reason that the UTM coordinates you can see on the GPS are **NOT** identical with the coordinates you can see on Google Earth.

Example former MC CP 101 at S10:

	Zone	*x (easting)*	*y (northing)*	*Precision*
WGS84/UTM	UTM 37 T	723517	4724465	1 m
GARMIN GPS with Correction	UTM 37 T	723717 UTM +200	4726465 UTM +2000	1 m
QGIS / EPSG 28407 (Pulkovo 1942/ Gaus-Krüger)	GK 7	7723725	4726470	1 m
old Map U.S.S.R	37	7723725	4726470	1 m
Grid Reference UNOMIG	(no information)	237	264	100 m
Square UNOMIG	(no information)	23	26	1 km

1.5 Difference between GIS and CAD

GIS was developed to handle 2-dimensional geographical data. Modern GIS tools are able to include the elevation of the terrain which makes GIS 3-dimensional. However, we have still the principle of different 2-dimensional layers.

This is the big difference between GIS and CAD-Software (Computer Aided Design). The later is able to manage 3-dimensional data properly. However, CAD program are developed for designing buildings, structural and civil engineering, engines and similar objects mostly shorter than 1 km and not to manage geographical data with a dimension mostly greater than several kilometers.

2 First Steps in Quantum GIS

2.1 What is Quantum GIS?

Quantum GIS, short QGIS, is an Open Source GIS. Open Source means that the program and the program code is free available. Everybody may have the possibility to improve the software. There is a QGIS developer team which voluntarily maintains the software and creates new versions compatible for LINUX, MAC and Windows.

There are several Open Source GIS. The most known is GRASS (Geographic Resources Analysis Support System). However, GRASS is more sophisticated and therefore also more difficult to use than QGIS. QGIS has nearly all functions we need here in UNOMIG and support the most common types of spatial data format. Even my followers in OPS may change the GIS-System, the GIS-Data are NOT lost. Among all GIS-Tools, QGIS has a high ranking, a good reputation and is able to include GRASS Tools.

We use the Version QGIS 1.0.0 “Kore”. This version is available under http://qgis.org/ (access: 2008-12-24). There is a User Manual (including installation guide) as well.

On Windows, you need administrator rights to execute the QGIS Setup.

2.2 Open and adjust Quantum GIS

After the installation of QGIS you should have the QGIS label on your desktop or at least you should have in your Program-Folder the Program QGIS. Start this program now. Your screen should show more or less the same picture than Fig. 8.

When you open the program the first time, please activate all standard Plugins:

→ (Menu) Plugins → Manage Plugins… → (Button) Select All

After the installation of the Plugins, a lot of icons in the toolbar appear. In order to convenient working, you should arrange the toolbars that you can see all icons. The navigation toolbar is very important an should be placed somewhere at the left side. If you point the mouse courser to an icon, a text indicates the function of the tool. e.g., with the "hand" you can move the map, with the loupe you can zoom in (+), zoom out (-), …

The main window of QGIS has two sub-windows. On the left, a small window which displays the Geodata loaded for the map; on the right we have the main window which shows the map in preview.

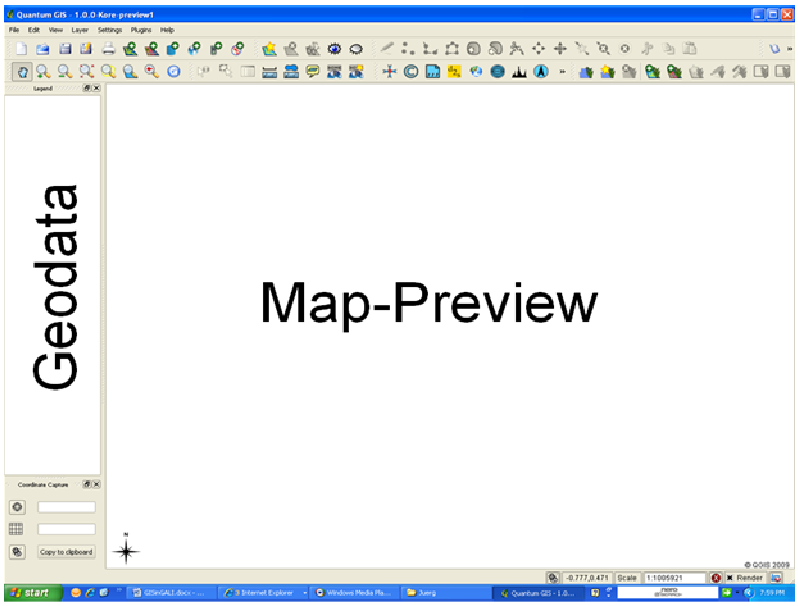


Fig. 2.1 QGIS main window with two sub-windows. Left: legend, list of linked Geo-data, Right: Map-Preview

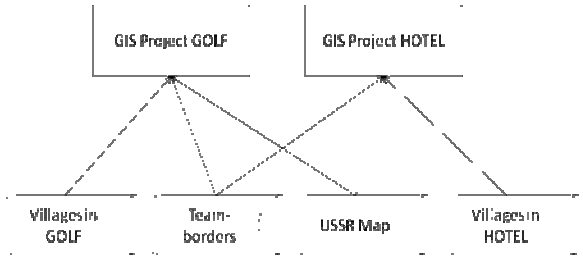
2.3 Manage QGIS Project by given geographical Data

As mentioned in Chapter 1, a GIS-Project links different geographical data together. However, in a GIS Project there are NO geodata stored. A GIS-Project contains following information:

- Projection parameters and coordination system
- Link to the geodata
- How each layer (geodata) should be displayed (symbol, legend, transparency)
- The order of the different layers
- The scale, the perimeter and the layout of the map

(et al.)

Following example should demonstrate the difference between GIS-Project and GIS-Data.



Project 1 contains GOLF AOR with the base of the old map of U.S.S.R, the borders between the teams and the villages in GOLF AOR.

Project 2 contains HOTEL AOR with the same geodata then Project 1 but with the villages in Hotel instead of GOLF AOR.

In *Project 1* we can define the color/style of the teamborders as green and solid, in *Project 2* we can defined the color/style as red and dashed. However, when we change the location of the border, then we change the geodata and this will effect *Project 1* and *Project 2* simultaneously.

Be aware if you make a change on project-level or on geodata-level. After editing/changes make sure that you safe the project AND the geodata as well.

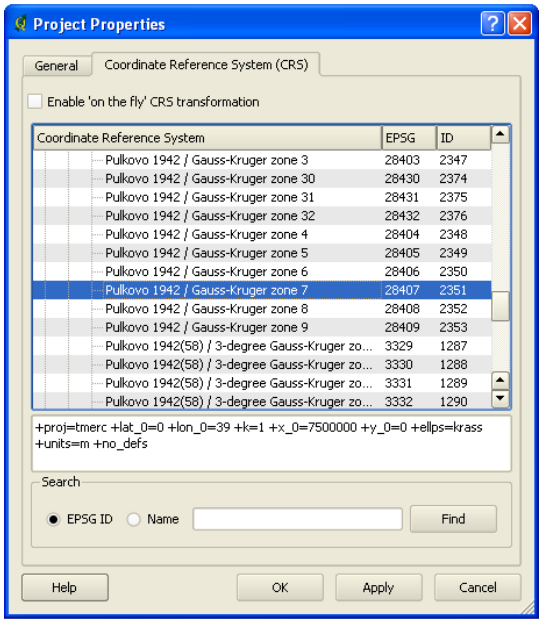
2.3.1 Create, safe and open a Project

Before adding geodata to a project, you should set the project properties first. Under
→ (Menu) Settings → Project Properties… you have two Tabs.

General:

- set Map units to Meters

The rest should be o.k.


Project Properties
General
Coordinate Reference System (CRS)
Enable 'on the fly' CRS transformation
Coordinate Reference System
EPSG
ID
Pulkovo 1942 / Gauss-Kruger zone 3 28403 2347
Pulkovo 1942 / Gauss-Kruger zone 30 28430 2374
Pulkovo 1942 / Gauss-Kruger zone 31 28431 2375
Pulkovo 1942 / Gauss-Kruger zone 32 28432 2376
Pulkovo 1942 / Gauss-Kruger zone 4 28404 2348
Pulkovo 1942 / Gauss-Kruger zone 5 28405 2349
Pulkovo 1942 / Gauss-Kruger zone 6 28406 2350
Pulkovo 1942 / Gauss-Kruger zone 7 28407 2351
Pulkovo 1942 / Gauss-Kruger zone 8 28408 2352
Pulkovo 1942 / Gauss-Kruger zone 9 28409 2353
Pulkovo 1942(58) / 3-degree Gauss-Kruger zo... 3329 1287
Pulkovo 1942(58) / 3-degree Gauss-Kruger zo... 3330 1288
Pulkovo 1942(58) / 3-degree Gauss-Kruger zo... 3331 1289
Pulkovo 1942(58) / 3-degree Gauss-Kruger zo... 3332 1290
+proj=tmerc +lat_0=0 +lon_0=39 +k=1 +x_0=7500000 +y_0=0 +ellps=krass +units=m +no_defs
Search
EPSG ID
Name
Find
Help
OK
Apply
Cancel

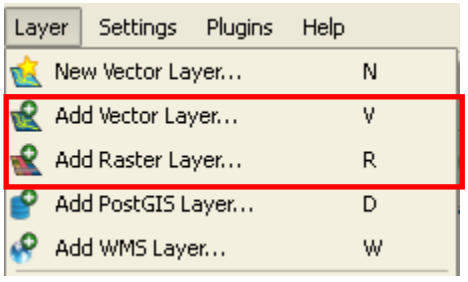
Coordinate Reference System:

open **Projected** Coordinate Systems, select *Pulkovo 1942 / Gaus-Kruger zone 7 (EPSG 28407)*

Now save the project. The path and the file name should correspond to the instructions given in Chapter 3. The suffix of QGIS projects is .qgs. QGIS project files are XML text-files.

You can open a QGIS project file by opening the program, and then under
→ (Menu) File → Open Project…
In WINDOWS XP you can also define that .qgs files have to be open with QGIS.

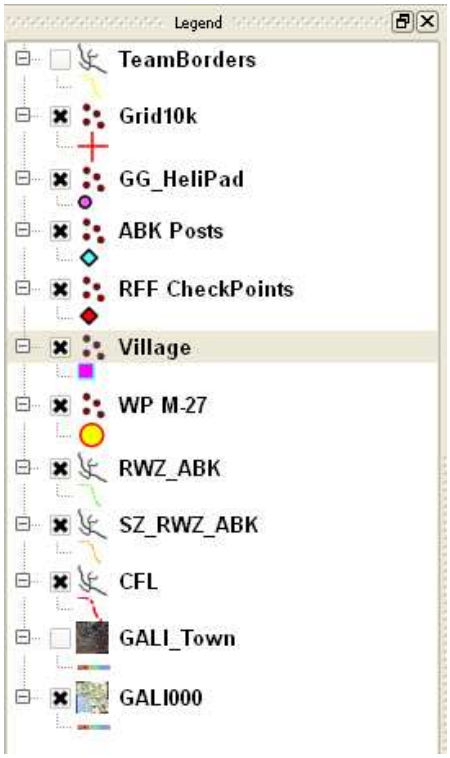
2.3.2 Adding existing Geodata



→ (Menu) Layer → …

Mostly we add Vector Layer or Raster Layer. Make your choice and then you can browse to the exiting Geodata.

The new Layer will appear on top front.

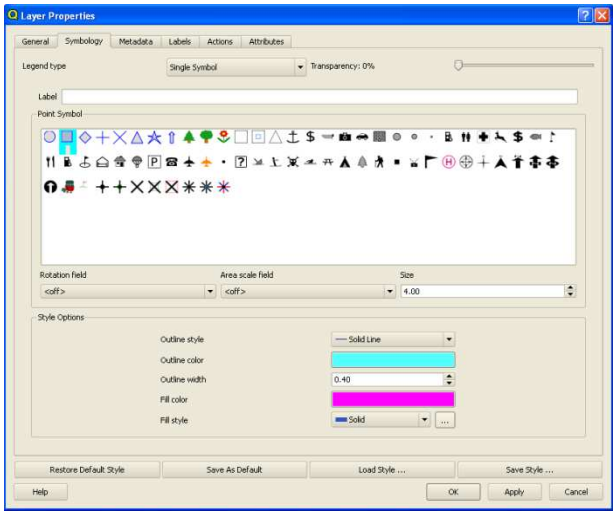


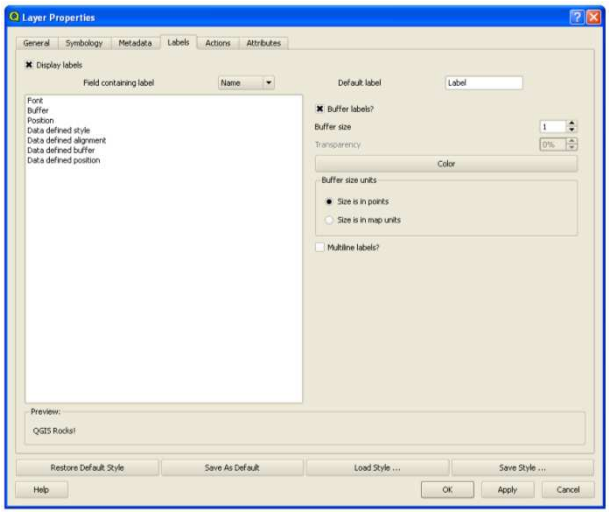
On the left hand side you have the legend of all layers. The item on the top (e.g. Team Borders) will be displayed in the front, the end (e.g. GALI000) will be displayed in the back.

It is wise to show the layers in following order (front to back)

1. Point symbols
2. Lines
3. Polygons
4. Grid-Layers

2.3.3 Layer Properties, Customize Symbology, Legend





You can change the layer properties by a mouse double-click on the item in the Legend Window.

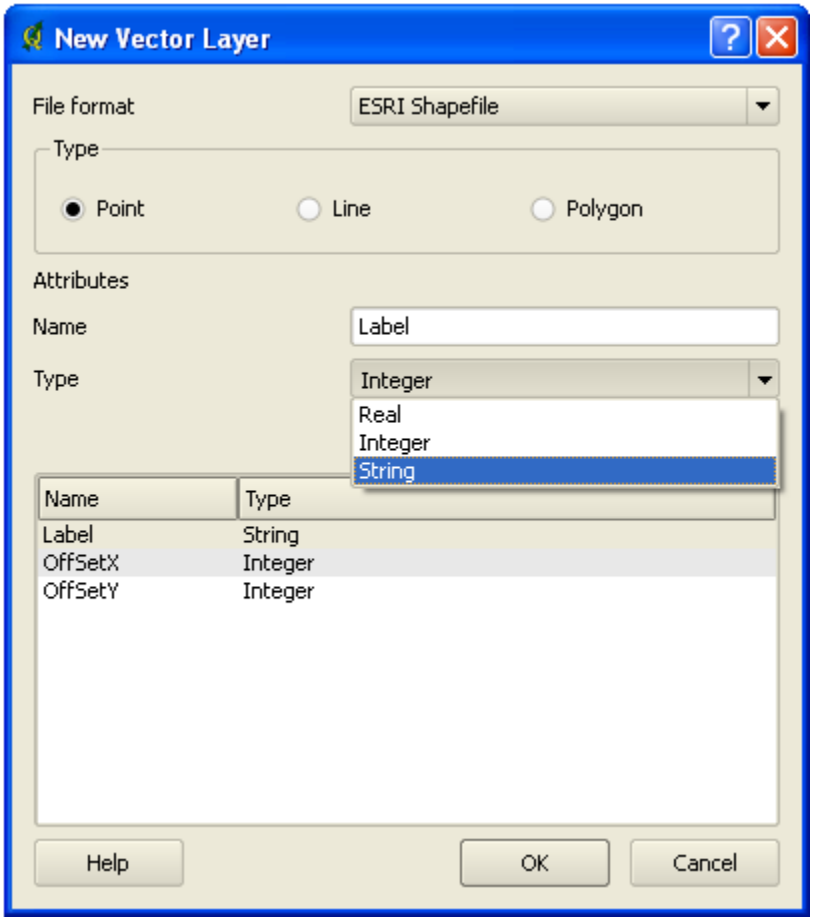
For designing a map, the tab "Symbology" and "Legend" are most important.

2.4 Create and editing Vector Layer

2.4.1 Create a new Vector Layer

In Chapter 1 we discussed the different data types for GIS-Data. As we have here in UNOMIG useful basic maps and orthophotos (raster data), we mark new positions, new roads, and other objects in Vector Layers.

To create a new Vector Layer, use → (Menu) Layer → New Vector Layer…



In this form you have to define the Type (Point, Line, Polygon) and at least one Attribute. An attribute is an information that you can add to the object. An attribute is either a REAL number (number with decimals, e.g. 3.14159), an INTEGER number (number without decimals, e.g. 123), or a STRING (small Text, e.g. "ABK SP 31"). Please define for any vector layer at least following 3 attributes

- Label (as STRING): This Label can be displayed on the map
- OffSetX (as INTEGER)
- OffSetY (as INTEGER)

OffSetX,Y can be used when we will shift the label on the map either in x or y direction.

After defining all attributes, click OK. You will be ask, where to save the new Vector Data.

2.4.2 Edit a Vector Layer

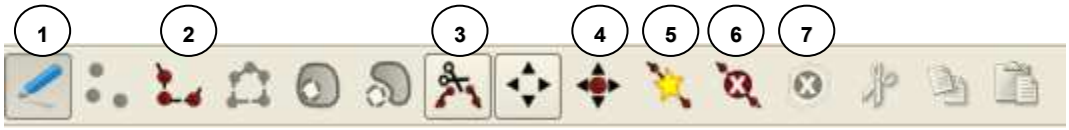
First you have to select a layer. Then you have to start the editing mode. Click on the blue pen (1) in the toolbox. Depending of the layer type (point, line, polygon) you have different options.

After you have done all edits, you have to leave the editing mode. Click again the blue pen (1). You will be ask if you will save the edits or not. When you close the project without finishing the edit mode, your edits will NOT be saved!

Point-Layer:

You can add new points by tool (2) or delete points with tool (3)

Line-Layer:



(1) starting, ending edit mode
(2) create a new line
(3) cut a line in two pieces
(4) move a vertex
(5) add a new vertex
(6) delete a vertex
(7) delete the whole line

2.5 Set a georeference to an image

When you have a scanned map, Satellite image or an Orthophoto, you can load this image to QGIS. However, you have to assign to the image a spatial reference, also called georeference.

QGIS provide a special Plugin to assign the georeference to an image.

(Menu) Plugins → Georeferencer… → Georeferencer

c.f. Figure 2.2

(1) First you have to load the specific image file
(2) then choose Transform Type "Helmert"
(3) create at least 3 points on the map and define the coordinates. It is recommended to choose 4 points near the corner of the map.
(4) save the Georeference [Create]
(5) [Create and load layer]
(6) Warp Option: Resampling method = Cubic; Compression = NONE; ☒ use 0 for transparency (c.f. Figure 2.3)

The new Layer will appear in Qantum GIS.

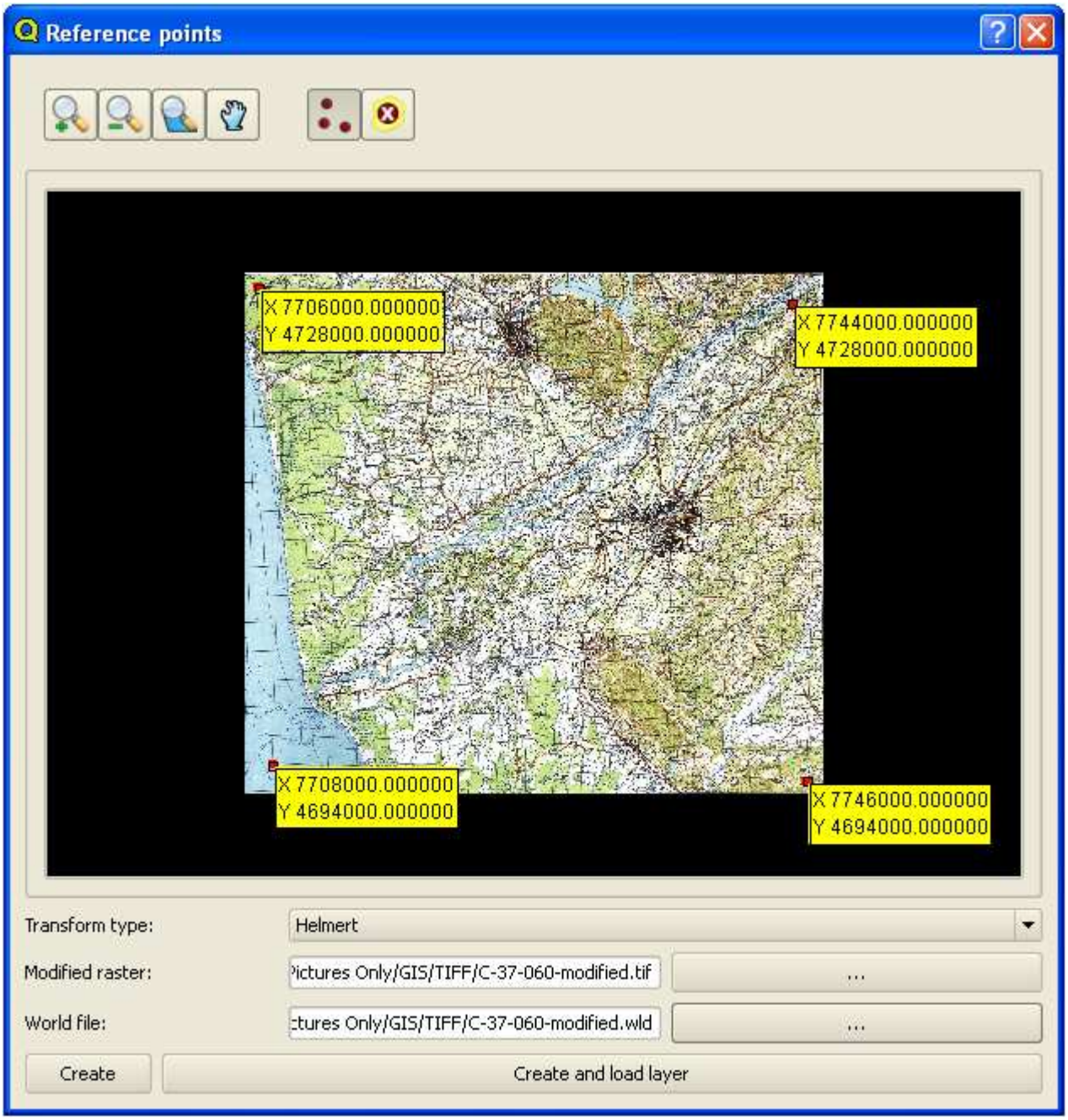


Fig. 2.2 QGIS Window for georeferencing an image

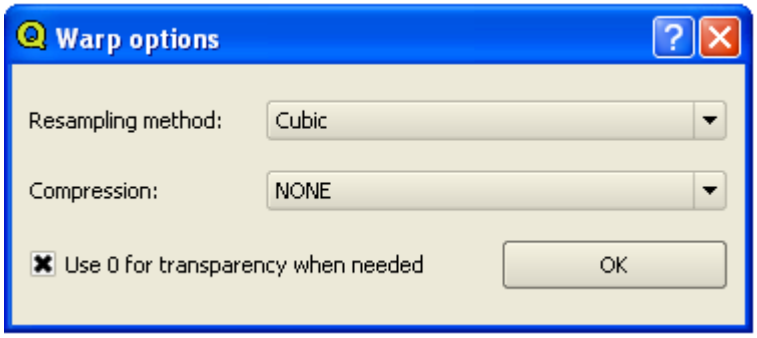


Fig. 2.3 QGIS Dialogue for resampling image with spatial reference

2.6 How to transform “UNOMIG false UTM” Data to “Pulkovo 1942” format

As mentioned Unfortunately the GARMIN GPS eTrex (2005) does not know the Pulkovo projection, that’s why we use the WGS84/UTM system Zone 37 (EPSG 32637), Zone 38 (EPSG 32638) and correct the data with +200m East / +2000m North. As mentioned before, in UNOMIG we use for GPS false WGS84/UTM data so that the display shows the same coordinates then the old Maps of the U.S.S.R. (Pulkovo 1942)

When we upload data from GPS to GIS, we have to transform these data from "false UNOMIG UTM" to Pulkovo 1942 /GK 7 (or GK 8) projection.

There is a user defined projection, which display the “false UNOMIG UTM” to the right place in the Pulkovo System:

UNOMIG_to_28407:

```
+proj=tmerc +lat_0=0 +lon_0=39 +k=1 +x_0=7499800 +y_0=-2000 +ellps=krass
+units=m +no_defs
```

Procedure:

1. Open a QGIS Project and change/verify the Coordinate Reference System to WGS84/UTM 37N (Settings > Project Properties > CRS = EPSG 32637)
2. Add Vector Layer (*Shp0*) with “false UNOMIG UTM” coordinates
3. Change/verify the CRS for WGS84/UTM 37N of *Shp0* (activate Vector Layer *Shp0* > right Mouse Button > Properties > General > Change CRS = EPSG 32637)
4. Export Shp0 with an other CRS = UNOMIG_to_28407. (Activate *Shp0* > right Mouse Button > save as ShapeFile > Name *ShpNew* [Save] > Projection Selector CRS = UNOMIG_to_28407
5. Open a QGIS Project with CRS Pulk/GK7 (ESPG 28407)
6. Add Vector Layer *ShpNew*
7. Change CRS of *ShpNew* to Pulk/GK7 (activate Vector Layer *ShpNew* > Properties > CRS = ESPG 28407.

3 Data structure

Sections 3.1 to *3.5* describe the data structure for GALI Sector. However, the data structure is nearly identical in ZUGDIDI Sector, there are small differences only. For example, there are no Layers for Abkhazian Troupes on Zugdidi side, instead there are positions of MIA and Police HQ. *Section 3.6* describes the modification for ZUGDIDI Sector.

3.1 Main Structure in GALI Sector (likewise in ZUGDIDI Sector)

All GIS-data should be available for the whole GALI Sector, except secret information. At the moment there is no server available which is able to save geodata (blocked by IT policy), that's why the data are on a shared drive.

At December 2008 all data are in \\MIG09052\GIS\. However, this may be temporarily only. In this documentation the place is named \\Server\GIS\ were Server stands for any root-location of the GIS software, data, projects and output.

\\MIG09052\GIS → \\Server\GIS\

When we look into \\Server\GIS\ we see following folders:

Software	Here you have all files such as QGIS, Manuals, GARMIN-GPS Tools
BasicMaps	Here there are all scanned or digitalized maps of the area without any georeference.
GISData	Here there are all geographical data with its georeference
GISProjects	All GIS-Project ("a user defined mix of GISData") are stored in this folder.
ReadyToUse	All maps with the finial layout are stored in this folder. Ready to use maps are either PDF (favorable), JPG/PNG/BMP, or PowerPoint (not preferable).

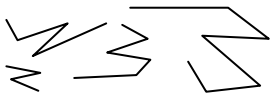
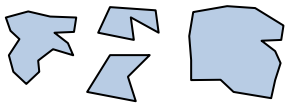
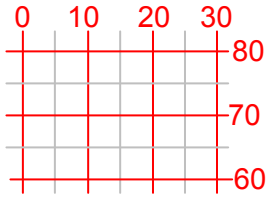
3.2 Secondary structure

Within GISData or GISProject we the data are structured in different sub-folders according the regional or functional topics.

\GIS\GISData	\GIS\GISProjects	
UNOMIG	{ }	Geodata for all UNOMIG region (e.g. Waypoint of M-27)
GALI	{ }	Geodata for all GALI sector (e.g. CFL, Team-Borders)
GMIO	GMIO	Data or Projects created by Gali Military Information
GOPS	GOPS	Data or Projects created by Gali Operation
GGolf	GGolf	Data of Golf AOR (e.g. Villages, RFF Positions, Helipad). Projects of Golf Team base
GHotel	GHotel	Data of Hotel AOR, Projects of Hotel Team base
GIndia	GIndia	Data of India AOR, Projects of India Team base
{ }	Styles	A style contains the definition, how a topic should be displayed. In order to simplify creating further project, some basic styles are stored in this folder.

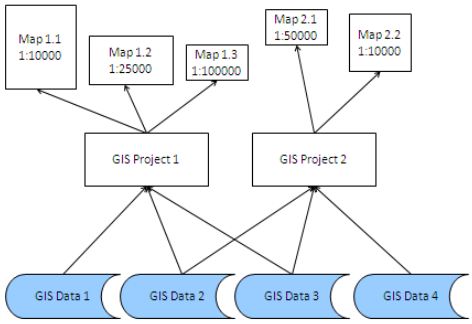
3.3 3rd-order structure

Some GIS-Data folders (e.g. \\Server\GIS\GISData\GALI\) have an additional sub-sub-folder structure, grouped by the format of the data.

sub-sub-folder		
Points	Point Shape file, e.g. checkpoints	
Lines	Line Shape file, e.g. borderlines	
Polygons	Polygon Shape file, e.g. minefields	
TIFF	Georeferenced images in TIFF (Tagged Image File Format), e.g. Satellite image of GALI-Town	
Graticule	Graticules are point-shape-files or line-shape files in order to visualize the grid reference / coordinate system on the map.	

3.4 Policy of Filenames

3.4.1 File Names for Geodata



You find all Geodata in the folder "GISData".

Most geodata are not stored in one file but in different files. It is reasonable to store all files belonged to one item in one folder. The folder should be named identically then the files inside the folder (except the extension). For the naming it is reasonable to apply following structure:

1. Abbreviation for Location / Area

{ } entire zone of conflict (e.g. CFL)
GG_ Gali Golf AOR
GH_ Gali Hotel AOR
GI_ Gali India AOR

2. Topic

_VilCent	Center of the village or town (administration building, main square, main junction)
_RFF_CP	Checkpoint of the Russian Federation Forces
_ABK_SP	Abkhazian Security Posts
_HeliPad	Helicopter landing sites
_WP	Waypoints

3. Date

The date is not mandatory. When no date is given in the filename, then we assume there are the most recent data we have. When we have information which stress a specific situation at a specific time (e.g. the situation of 15th October 2008, the end of the 1994 Moscow Agreement of), the date should be a part of the filename.

Some type of files has a limitation of the length of the filename. If possible, write the date in the format YYYYMMDD which means 4 figures for the Year, 2 figures for the Month, and 2 figures for the Day, e.g. 20081015 for October 15, 2008. Otherwise indicate the Year and Month only in the Format YYDD, e.g. 0810 for October 2008.

Examples:

GH_ABK_Post	GALI Hotel AOR, Abkhazian Security and Tax-Posts. There are the most recent data. However, you can see the exact date of the last change in the column "Date Modified" as a property of any WINDOWS file.
GI_VilCent_0807	GALI India AOR, Village Centers with the key figures of each village. Situation of July 2008, before the war of August 2008.

3.4.2 Shape File and Shape File Names

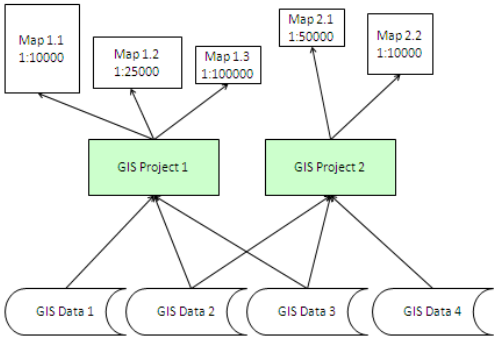
Shape-Files are vector (points, lines, polygons) data, a subset of geodata. ESRI, the leading company for commercial GIS, has a specific structure for Shape files. Actually, a shape file contains a bundle of different files which are stored in one specific folder. All name must be identical, the suffix is different.

Example:

CFL	Folder	
	CFL.shp	Shape file with spatial data
	CFL.shx	indices for the spatial data
	CFL.prj	projection of the spatial data
	CFL.dbf	dBASE table with the attributes of the features

The file name should not exceed the length of 16 characters. Please use only characters, figures, no wildcards and no spaces. The structure of the filename is given in Subchapter 3.4.1.

3.4.3 GIS Project File and Project File Names



All GIS project are stored in the folder "GIS-Projects"

QGIS projects file names has the suffix (extension) *.qgs. In WINDOWS this type of file should be open by QGIS automatically. Otherwise you can open first QGIS, then open the relevant project.

QGIS project files contains in XML structure every information about projection linked geodata and layout. For advanced users it is possible to make amendments with a text editor directly in this XML file.

The file name has no limitation as long it is a valid file name of the operation system (e.g, WINDOWS the max. length is 255 characters, some wildcards are forbidden). However, it is reasonable to respect following structure:

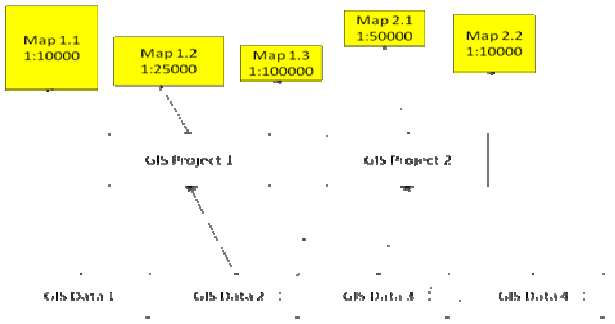
1. Location / Area e.g. GaliAOR
2. Main Topic or purpose e.g. Heli
3. Date (Year, Month, Day) e.g. 20090215 (i.e. February 15, 2009)

- Avoid spaces and use underscore "_" to separate Location_Topic_Data
- The filename should not exceed the length of 32 characters

Examples:

GaliAOR_Heli_20090215.qgs	This QGIS Project shows within the entire GALI Sector all Helipads. Created or updated at 15th February 2009.
GHotel_Patrol_20090215.qgis	This QGIS Project shows the Hotel AOR and is designed for patrolling. Created or updated at 15th February 2009.

3.4.4 File names for finalized maps



You find all finalized maps in the folder "ReadyToUse".

Finalized map should be preferably stored as PDF file (Portable Dokument Format). However, PowerPoint or JPG, TIFF or other image formats are also possible.

The structure of the filename has following parts:

1. Location / Area e.g. GaliAOR
2. Main Topic or purpose e.g. OPS
3. The suggested paper format/size e.g. A4, A3, A2, A0
3. Date (Year, Month, Day) e.g. 20090215 (i.e. February 15, 2009)

- Avoid spaces and use underscore "_" to separate Location_Topic_Format_Data
- The filename should not exceed the length of 32 characters

Example:

GaliAOR_OPS_A0_20090215.pdf Whole GALI AOR, main map for OPS office, paper format/size ISO A0, date February 15, 2009.

3.5 Description of Shape Files Attributes

Every shapefile has a *.dbf file (dBASE) which contains additional information to the shape. This information is also called attribute. For example, the label "CP 201" is an attribute of the checkpoint at S12. We can edit dBASE tabels with specific dBASE reader/editor programms, e.g. OpenOffice Calc.

3.5.1 Description of "Village" (GALI AOR only)

Filename: VilCenter, format: Point Shape file

Indicates the center of the village (or town), e.g. administration building, school building, main square, main junction. Even this is a point shape, the attributes contains the information for the whole municipality.

Attribute	*Format*	*Length / Precision*	*Description*
Name	string	80	Display label on the map
Inhabitants	integer	10	Number of inhabitants
rGEO	real	19	Ratio (0..1) of Georgia friendly population. rGEO = 1 - rABK
rABK	real	19	Ratio (0..1) of Abkhazia friendly population. rABK = 1 - rGEO
OffSetX	integer	10	Horizontally shifting of the Label in points. (1 pt ≈ 0.35 mm)
OffSetY	integer	10	Vertically shifting of the label in points. (1 pt ≈ 0.35 mm)

3.5.2 Description of "RFF Position" (GALI AOR only)

Filename: RFF_Pos, format: Point Shape file

RFF Position (Russian Federation Forces) such as CP, HQ, artillery position, tranches or shelters.

Attribute	*Format*	*Length / Precision*	*Description*
Label	string	80	Display name on the map
Unit	string	80	Name of the unit
TRP	integer	10	Number of persons
OffSetX	integer	10	Horizontally shifting of the label in points. (1 pt ≈ 0.35 mm)
OffSetY	integer	10	Vertically shifting of the label in points. (1 pt ≈ 0.35 mm)

3.5.3 Description of "Abkhazia Posts" (GALI AOR only)

Filename: ABK_Pos, format: Point Shape file.

Abkhazian Security Post (SP), Tax Post (TP), HQ or positions.

Attribute	*Format*	*Length / Precision*	*Description*
Label	string	80	Display name on the map
Unit	string	80	Name of the unit, e.g. State Security Service (SSS), Border Guards, Custom, Traffic Control, etc.
TRP	integer	10	Number of persons
OffSetX	integer	10	Horizontally shifting of the label in points. (1 pt ≈ 0.35 mm)
OffSetY	integer	10	Vertically shifting of the label in points. (1 pt ≈ 0.35 mm)

3.5.4 Description of "Heli-Pad"

Filename: HeliPad, format: Point Shape file.

Shows the Helicopter landing site

Attribute	*Format*	*Length / Precision*	*Description*
Label	string	80	Code of the Helipad
OffSetX	integer	10	Horizontally shifting of the label in points. (1 pt ≈ 0.35 mm)
OffSetY	integer	10	Vertically shifting of the label in points. (1 pt ≈ 0.35 mm)

3.5.5 Description of "Waypoints"

Filename: WP, format: Point Shape file.

Shows the Reporting Points

Attribute	*Format*	*Length / Precision*	*Description*
Label	string	80	Code of the Helipad
Type	integer	10	Indicates the level of the Way-points. 0: M-27, 1: permanent way-points in the area, 2: temporarily waypoints
Descr	string	80	Short description of the point (c.f. Main Location List)
OffSetX	integer	10	Horizontally shifting of the label in points. (1 pt ≈ 0.35 mm)
OffSetY	integer	10	Vertically shifting of the label in points. (1 pt ≈ 0.35 mm)

3.5.6 Description of "Roads"

Filename: Roads, format: Line Shape file.

Shows the road net and the quality of the ZOC

Attribute	*Format*	*Length / Precision*	*Description*
Label	string	80	Display label on the map
Name	string	80	Name of the road
Patrol	string	80	Suggestion to use for patrol. - fast e.g. Zugdidi - Lia - normal e.g. Ruchi - Rike - possible road to Kalagali - restricted not possible when wet - adventure only possible by good soil and weather condition by very experienced drivers
Softskin	binary	0/1	Possible for soft skin vehicles (4x4, 2 tones)
Hardskin	binary	0/1	Possible for hard skin vehicles (4x4, 3.5 tones)
Nyala	binary	0/1	Possible for Nyala (11 tones)
Standard	string	80	Indicate the type of the road: - 2-track road - 1-track road - gravel road - earth road
Quality	string	80	Quality according to the standard. good / middle / bad
minutes	real	19	Expected time to drive the se-quence in minutes.

3.6 Modification for ZUGDIDI Sector

3.6.1 Server Space in ZUGDIDI

At the moment, the Data are stored on `T:\Official Pictures Only\GIS`

IT will allocate another specific server space soon.

T:\Official Pictures Only\GIS → \\Server\GIS\

3.6.2 Description of "Village"

Filename: VilCenter, format: Point Shape file

Indicates the center of the village (or town), e.g. administration building, school building, main square, main junction. Even this is a point shape, the attributes contains the information for the whole area of the village.

Attribute	*Format*	*Length / Precision*	*Description*
Label	string	80	Display label on the map
Descr	string	80	Kind of the Location. e.g. Admin. building, School, Main junction.
Name	string	80	Name of the Village according the Main Location List.
Municip	string	80	Name of the Municipality
District	string	80	Name of the District
Inhabit	integer	10	Number of inhabitants of the village or town. Please do not mix up this figure with the number of the whole municipality.
Rem	string	80	Remarks
UpDate	string	80	Date of the latest modification. Format YYYY-MM-DD e.g. 2009-05-10 is 10th May 2009
OffSetX	integer	10	Horizontally shifting of the label in points. (1 pt ≈ 0.35 mm)
OffSetY	integer	10	Vertically shifting of the label in points. (1 pt ≈ 0.35 mm)

3.6.3 Description of "Civil"

Filename: Civil, format: Point Shape file

All relevant objects for civilian use including sight seeing objects

Attribute	*Format*	*Length / Precision*	*Description*
Label	string	80	Display label on the map
Name	string	80	Name of the object
Type	string	80	Kind of the object, e.g. school, dispensary, church, castel
OffSetX	integer	10	Horizontally shifting of the label in points. (1 pt ≈ 0.35 mm)
OffSetY	integer	10	Vertically shifting of the label in points. (1 pt ≈ 0.35 mm)

3.6.4 Description of "Military Observations"

Filename: MilObs, format: Point Shape file

In absence of RFF on ZUGDIDI AOR, there is only ONE Layer with all relevant information for military observing such as former CIS/PKF Installations, MIA Installations, Police HQ and more.

Attribute	*Format*	*Length / Precision*	*Description*
Label	string	80	Display name on the map
Name0	string	80	Name according the actual Main Location List
Name1	string	80	Synonym / alternative name
Name2	string	80	old or former name
Type	string	80	Kind of the location: HQ: Headquarter CP: Check Point OP: Observation Post SP: Security Post TP: Tax Post Shelter Trench System BTR-Position
Branch	string	80	Type of group/unit who occupy the location. - RFF - ABK SSS - MIA (geo) - Police
Unit	string	80	Name of the unit
TRP	integer	10	Total number of persons (rough estimation is enough)
SA	integer	10	Total estimated number of Small Arms (caliber < 14.7mm)
HW	integer	10	Total estimated number of Heavy Weapons (caliber ≥ 14.7mm)
Rem	string	80	Remarks
UpDate	string	80	Date of the latest modification. Format YYYY-MM-DD e.g. 2009-05-10 is 10th May 2009
OffSetX	integer	10	Horizontally shifting of the label in points. (1 pt ≈ 0.35 mm)
OffSetY	integer	10	Vertically shifting of the label in points. (1 pt ≈ 0.35 mm)

References and Contact

R1 General GIS-References

There are many references available on-line. We know that Internet links may chang frequently. Here are some links accessed 2009-02-15.

http://www.gitta.info/	Geographic Information Technology Training Alliance. Here are a lot of self tutorials, training modules to learn GIS.
http://en.wikipedia.org/wiki/Geographic_information_system	Wikipedia is always a good source to get a general overview of GIS.
http://training.esri.com/gateway/index.cfm	ESRI is one of the leading company or most probably THE leading company in matter of GIS. Some free tutorials are available on this site. The products it selves are very expensive. However, the prices increase year by year and the quality decrease simultaneously. That's why a lot of clients get more and more angry about ESRI and Open-GIS gains popularity.
http://spatialreference.org/	This website provides information about every projection and coordinate reference system.
http://freegeographytools.com	Here are several free GIS tools available, e.g. converter from shape-files to text files, DBF editors, etc…

R2 QGIS References

http://www.qgis.org/	This is the main homepage of Quantum GIS. New updates and user manuals are available here for free.
http://download.osgeo.org/qgis/	QGIS is an OS-Geo project. Confer this site as well for new manuals and updates.

R3 Contact and Support

If you need support, do not hesitate to contact the initiator of the GIS project in UNOMIG and author of this short manual.

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